FOREST PEST MANAGEMENT
Pacific Southwest Region

Report No. 81-35

3430 Evaluation
December 9, 1981

BROWNING AND DEFOLIATION OF PONDEROSA PINE EAST OF JUANITA LAKE, GOOSENEST RANGER DISTRICT, KLAMATH NATIONAL FOREST

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ABSTRACT

The cause of needle mortality on ponderosa pine east of Juanita Lake remains enigmatic. Several possibilities are considered and pesticide drift from the nearby agricultural valley currently fits the symptoms and developmental patterns more closely than other possiblities.

INTRODUCTION

In May 1981, personnel of the Goosenest Ranger District, Klamath National Forest, noticed that ponderosa pines on National Forest land east of Juanita Lake were beginning to turn brown. These pines were located on lower, east-facing slopes near the plain of Butte Valley. As the summer passed, the area expressing symptoms expanded to cover parts of T. 46 N., R. 2 W., Secs. 15, 16, 21, 22 and 28. North to south the browning covered 1 1/2 to 2 miles at most and symptoms remained below the first ridge of hills. On August 27, 1981, we met with Tom Hamilton and Paul Nazerienko from the Goosenest District to examine these browning ponderosa pines. The area also was examined by David Schultz, entomologist, and John Kliejunas, plant pathologist, on November 4th.

OBSERVATIONS

The stand in which the symptoms occurred is a mixture of relatively open-grown ponderosa pine, Douglas-fir, incense-cedar and numerous western juniper. Few trees are larger than pole-size or taller than 50-60 ft. Growth of the pines is presently about 8 rings per inch. Site quality is rated at a "low 4".

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Only ponderosa pine had extensive browning foliage, but not all pines were affected equally. Two zones could be distinguished. The first was located along the lower slope near the valley floor. Older needles had turned brown or were turning brown. Numerous flushes of new foliage had died in the spring without achieving full growth. Buds on these branches frequently were dead and there was some twig dieback. Upslope, some emerging foliage had been killed, but the buds remained alive. Browning of older needles had occurred, but the intensity and number of pines affected was less than downslope.

Browning of the needles occurred more commonly and intensely on the side of the pines facing eastward toward the agricultural valley. The oldest needles turned brown first. Younger needles followed in reverse chronological order until all but the current needles had browned. Once the needles of a particular year were brown, they began to fall from the tree. By October 1981, many pines had lost all but the current needle complement of affected branches, and foliage on these trees had taken on a tufted appearance. Even though the 1981 foliage was not lost, some of these needles had turned brown and will eventually abscise.

Browning of needles begins with a band that initially occurs in two parts, a red-brown center band bordered on each end by a narrow band of yellow. The needles yellow distally from the band and eventually change from yellow to light brown. Usually the whole needle eventually yellows and turns brown, but needles were observed that had stabilized with a proximal portion green and the remainder brown. Up to 4 bands per needle were observed.

DISCUSSION

A number of possible causes for the browning and loss of needles have been considered.

Drought. The trees in the area should have been under stress in 1981 because precipitation was less than normal in 1980-81. This stress could accentuate and magnify the annual seasonal loss of the oldest pine needles. However, this annual phenological event could not be expected to cause the extent of premature loss of needles observed on most of the pines. This explanation also does not account for the needle banding observed, or the absence of browning and defoliation on the other tree species on the site.

Insects. Upon approaching the affected hillsides, the general appearance from a midground viewpoint was that of trees under attack by an insect needleminer or a defoliator such as the sugar pine tortrix. No insects that cause defoliation were found and bark beetles were not attacking the trees. Twig beetles were inconsequential. Many sucking insects feed upon needles and their feeding can result in discolored bands on the needles. But the feeding punctures which they make were not found within the bands examined under magnification, and sucking insects were not abundant in the trees on August 27th. Insects are not considered the cause of the browning and abscission of the needles.

Disease. There were no "centers" or other patterns of damage that often characterize involvement of root disease organisms. Also, root diseases do not produce such rapidly developing symptoms. The site appears not to have the necessary environmental conditions for the widespread development of a needle cast or blight fungus. Nevertheless, needle tissue from needles with incipient banding and yellowing was cultured in the laboratory for any fungi present in the needles. Needles were even taken from near the top of one tree for this purpose. Attempts at isolation proved negative and fungi are not considered causal at this time.

Pine Wood Nematode. The pine wood nematode has been found in exotic ornamental conifers in nearby Yreka, California, and it has been described as responsible for the death of ponderosa pine in shelterbelts in the northwestern Great Plains. Initial symptoms of infestation in Japanese red and black pines in Japan are similar to the symptoms seen east of Juanita Lake. Stress from drought and this apparently indigenous nematode could possibly combine to produce symptoms in a native conifer within its natural range without producing mortality.

Two increment cores and two twigs were removed in early October from 6 pines with pronounced symptoms of browning. These were soaked in water in a manner prescribed to extract the pine wood nematode. None were obtained and we do not believe the nematode is involved in producing the browning and needle loss.

Pesticide Drift. The common occurrence and intensity of the symptoms on the valley side of the trees indicates the possibility of pesticide drift. The chemical involved need not be a herbicide, for some insecticides can have phytotoxic effects under certain conditions. For example, the insecticide fenitrothion (Sumithion) is credited with causing abnormal leaf abscission of Chamaecyparis obtusa in Japan. The random occurrence of the bands on the needles fits with conjectured droplet deposition and incipient chemical effects. The hillside pattern of symptoms corresponds with atmospheric movement directly from the valley floor to the hillside.

Tree species vary in their susceptibility to damage by chemicals and this could account for the absence of symptoms on other species at the site. Occurrence of drift before shoot elongation could account for the light amount or absence of browning in 1981 pine foliage. Many chemicals rapidly degrade in the environment, and without knowing the chemicals used in the area, the patterns and times of use, and with confounding weather conditions, it would be difficult to obtain a definitive analysis.

CONCLUSION

Consideration of symptoms and possible causes have left us with a great deal of uncertainty and conjecture. However, at the present time, chemical drift from agricultural activity on the valley floor seems to fit conditions more closely than any other possibility. Moisture stress appears to have sharpened the effect on older needles. If this is the case, it would be unlikely that conditions would combine to produce the same effects in exactly the same location in 1982. But, they might well occur at some other nearby location.

The present area affected should be mapped, with periodic updates. Any other areas that develop symptoms should be mapped. For this purpose, District personnel should be observant in the spring of 1982. Personnel should familiarize themselves with local agricultural activities and the chemicals involved. FPM personnel will continue to monitor the area in 1982.

Weather patterns and precipitation levels for the winter of 1980-81 appear to be returning to normal. Average or above normal precipitation should assist the trees in recovering from the effects of losing so much of their foliage. But, if precipitation remains appreciably below normal in 1981-82, the area should be monitored for activity of pine engraver beetles, Ips spp. Also, the creation of slash and activity that would disturb the site or further weaken the trees, such as logging injury during thinning to lessen competition, should be avoided.